U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1394

WATERMELONS

WATERMELONS are grown for the market on an extensive scale in about 16 States, the main producing areas being located in the warmer parts of the country, on the light sandy or sandy loam soils.

Watermelons must be grown on new land or in a long-period rotation to avoid serious losses from diseases. Certain field diseases can be controlled by spraying. Seed treatment also helps. Losses from diseases during transit may be largely prevented by careful handling followed by proper treatment at the car.

Good seed is of great importance in the production of high-class melons for the markets, and there is great need for the improvement of present methods of seed production.

Watermelons respond to the use of moderate quantities of commercial fertilizers, the requirements in various sections and for various soils being somewhat different.

Careful handling is essential in the loading and shipment of watermelons. In sections where stem-end rot is prevalent, reclipping and treatment of the freshly cut stems is necessary.

As a rule, profits accruing from watermelon growing are not large, and the crop should be produced by the most economical methods.

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WATERMELONS

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DISTRIBUTION OF THE COMMERCIAL WATERMELON INDUSTRY

Watermelons are grown for the market over a wide range of territory, especially in the warmer sections of the United States. According to statistics contained in Crops and Markets covering the 10-year period from 1924 to 1933, inclusive, there was an average yearly movement of approximately 50,000 carloads from the 16 principal producing States. This does not include melons marketed locally or those grown in other States and shipped in less than car lots.

Certain sections of Georgia, Florida, Texas, North Carolina, South Carolina, Virginia, Missouri, and California are noted for their heavy watermelon production. The area planted to watermelons in the 16 principal producing States in 1933 was reported in Crops and Markets as 185,950 acres.

A yield of 350 to 400 marketable melons per acre is good. A 32- to 34-pound melon, which loads 800 to 1,000 to a car, is considered standard, although melons weighing as little as 18 pounds and loading 1,600 to a car are shipped. On a basis of 350 melons averaging 34 pounds, the yield is practically 6 tons to the acre. This is above the general average, however, but yields of 3½ tons to the acre are very common.

Watermelons are what might be termed a catch crop in many sections and are profitable only where good yields are obtained or where the crop is grown on new land that is being cleared and put in condition for other crops. In other sections, however, water-

[1] The section of this bulletin which is devoted to a discussion of diseases has been revised by F. C. Meier, senior agriculturist, Office of Cooperative Extension Work. The matter pertaining to insects has been revised by D. J. Caffrey, senior entomologist, Division of Truck Crop and Garden Insects, Bureau of Entomology and Plant Quarantine.

melons are considered a standard farm crop and are grown in the regular rotation.

The handling of watermelons is extremely precarious on account of the many factors that govern their sale on the market. Overproduction is one of the chief causes of loss, but weather conditions at the market are perhaps the most important factor. Cool rainy weather will cause breaks of the market, while clear hot weather will invariably stimulate the demand. Considerable losses are also caused by diseases which have their origin on the farm but develop during transit. Under existing conditions any decided increase in the acreage planted to watermelons for shipment, for the present at least, would be unwise, but there is great opportunity for improving cultural methods and for increasing both the yield and quality of the melons.

Watermelon shipments from southern Florida and southern Texas begin in April, and the season gradually moves northward until the end of the summer, or about October 1 in the more northern States. After the northern-grown watermelons are gone, California and Colorado continue to supply the market with special varieties, known as winter watermelons, which are available almost until Christmas.

TYPES OF SOILS ADAPTED FOR GROWING WATERMELONS

Rich sandy-loam soils are considered best for watermelons, but good crops are often grown on almost any type of well-drained warm and fertile soil. Throughout the Southern States, where the bulk of the early commercial crop is produced, the melons are grown very largely on new ground which has been recently cleared of its timber, the soil of which is full of decayed vegetable matter and withstands dry weather better than land that has been cropped for several years. The newly-cleared land also has the advantage that it ordinarily does not contain the diseases that so often cause serious losses of the crop.

The type of rolling sandy land on which watermelons are grown in the Southern States is illustrated on the title page of this bulletin. This kind of soil, however, is very subject to infestation by the root-knot nematode, and this fact should be taken into consideration in the selection of land on which to grow melons. Some of the heaviest yields are produced in the sandy river-bottom or delta soils of southeastern Missouri and in other sections having similar soil conditions. The essential requirements of soils on which watermelons are grown are that they be well-drained and warm, capable of being worked early in the spring, and contain an abundance of quickly available plant food.

CROP ROTATION

As already stated, watermelons are frequently grown as a clean-up crop on newly cleared land. However, in many sections, such as southeastern Missouri and central Texas, very little land is now being cleared, and watermelons must be grown in rotation with other crops.

From the standpoint of disease control, watermelons should not appear in the rotation oftener than once in 6 and preferably 8 or 10 years. This applies particularly on land where root-knot control

is a factor. In such cases resistance of the rotation crops to root knot must be a primary consideration.[2]

The intermediate crops in the South are usually corn and cowpeas, velvetbeans, cotton, winter oats, or peanuts, and in the North, corn and wheat, followed by clover or pasture. A crop of velvetbeans or clover turned under during the previous summer and allowed to decay will form an excellent supply of organic matter for the growth of watermelons. In Florida and southern Georgia the melons will be marketed in ample time for planting velvetbeans or cowpeas.

PREPARATION OF THE LAND

While watermelons are not an exacting crop as regards cultivation, it is essential that the land be well-plowed and fitted before being planted. On newly cleared land it is desirable that most of the sticks, roots, and trash that will interfere with cultivation be removed or burned, both before and after plowing. Quantities of small roots will be brought to the surface during the harrowing and fitting of the soil, and these should be piled around the stumps and later burned or hauled off the land. On old land, especially that which is in sod or has upon it a crop of velvetbeans, cowpeas, clover, or a similar crop, plowing should be done either in the fall or at some time during the winter when the ground is in suitable condition. Early in the spring the land should be thoroughly disked and harrowed or dragged before being planted. The same general preparation required for corn or cotton will apply to watermelons. While it is essential to have the land in good condition, too much expense is not justified. The work should be done by means of simple tools and economical methods.

MANURE AND FERTILIZERS

Barn or feed-lot manure free from the fungus causing wilt of watermelons may be used as a fertilizer at the rate of 4 to 6 tons to the acre, but it should be reasonably well-rotted and thoroughly mixed with the soil. The wilt fungus grows readily in stable manure, and a common source of infection is the feeding of hay containing diseased watermelon vines cut from fields after the crop is off. In districts where wilt is prevalent growers are advised to use extreme care to prevent the manure supply becoming infested; also to depend mainly upon soil-building crops and commercial fertilizers as sources of plant food.

The method of distributing manure will depend on the quantity available and the system of planting the watermelons. If not more than 3 or 4 tons to the acre are available and the melons are to be planted in hills, the manure should be worked into the hills. Where the melons are grown in a continuous row the manure is scattered in a furrow and a double furrow thrown over it, forming a slight bed, on which they are planted. If more than 3 or 4 tons of manure to the acre are available it can best be broadcast or scattered in a strip along the row and thoroughly disked into the soil. Experience has shown that manure, even where the quantity is small, worked

[2] Farmers' Bulletin 1345, Root-Knot: Its Cause and Control, contains lists of resistant and susceptible crops.

into the hills or rows is of decided value in giving the plants a strong early growth; provided, however, that the manure is free from the wilt fungus.

Chemical fertilizers are considered almost indispensable in the production of large acreages of watermelons. The Florida growers use from 600 to 800 pounds to the acre, applied in a strip along the row by hand or with a fertilizer distributor, as shown in figure 1. Special brands of watermelon fertilizers are supplied by the manufacturers and the formulas of these vary from 2 to 5 percent of nitrogen, 6 to 8 percent of phosphoric acid, and 3 to 6 percent of potash. A few of the Florida growers have tried using 1,000 to 1,200 pounds of fertilizer to the acre, but have come to the conclusion that 800

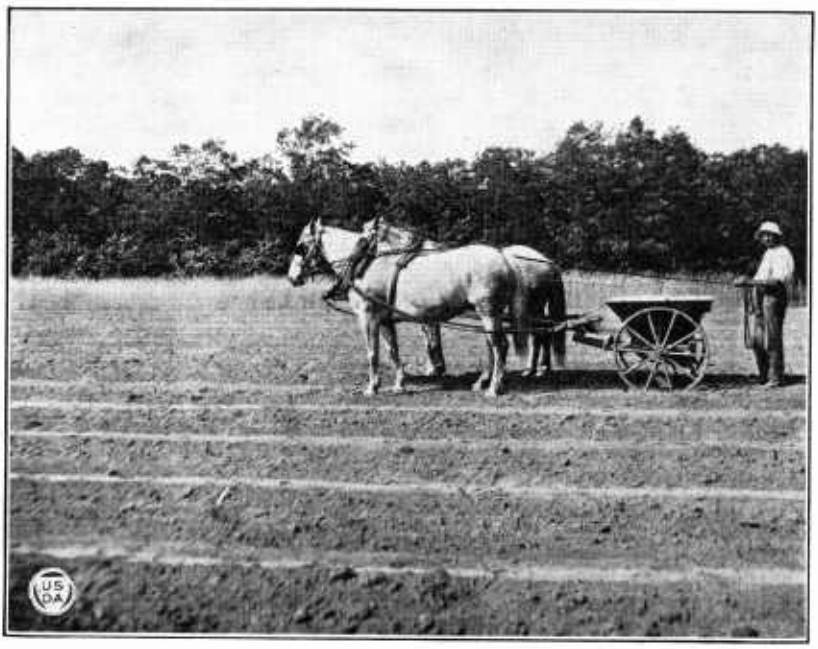

FIGURE 1.—Fertilizer distributor used for sowing fertilizer in a strip where the row is to be located.

pounds of a mixture containing 5 percent of nitrogen, 7 or 8 percent of phosphoric acid, and 5 percent of potash put down at one application is the most profitable.

The Georgia growers apply 500 to 800 pounds per acre of a fertilizer usually containing about 3 percent of nitrogen, 8 percent of phosphoric acid, and 3 percent of potash. Under normal conditions this fertilizer costs about $32 a ton. Where watermelons follow velvetbeans not more than 500 pounds of fertilizer is used.

In the Texas watermelon districts the soils usually contain an abundance of potash, and in many cases a fertilizer consisting of equal parts of cottonseed meal and 16 percent superphosphate is applied at a rate varying from 200 to 600 pounds to the acre. Many Texas growers use ready-mixed fertilizers; some, however, use superphosphate alone, especially on new land. Some of the

melon growers' associations of Texas prohibit using nitrate of soda as a top dressing, believing it makes the melons soft and of poor carrying quality, but experiments have shown this belief to be erroneous.

The watermelon growers of Missouri, southern Illinois, and other melon-shipping sections have developed local practices as regards the application of fertilizers, but as a rule not less than 200 pounds nor more than 800 pounds of a well-balanced mixture is applied. Many growers follow the practice of placing a little extra fertilizer directly in the hills and mixing this thoroughly with the soil, the object being to give the plants a good "send-off." Another method is to apply carefully a pinch of nitrate of soda near the plants just after they come up.

It would seem that growers in sections where a complete fertilizer is required might save something in freight rates by using pro-

FIGURE 2.—Watermelons of the Tom Watson variety, showing their characteristic ribbing.

portionately smaller quantities of higher grade mixtures that do not contain fillers which add no plant food. A fertilizer containing 5 percent of nitrogen, 10 percent of phosphoric acid, and 5 percent of potash contains practically no filler, and 640 pounds of this mixture has the same quantity of plant food as 800 pounds of a lower grade mixture carrying 4 percent of nitrogen, 8 percent of phosphoric acid, and 4 percent of potash.

VARIETIES OF WATERMELONS FOR SHIPPING AND FOR HOME USE

The variety known as Tom Watson (fig. 2) is widely grown throughout the southeastern United States. This variety has been popular for many years because of its splendid shipping qualities and its uniform shape and size, together with good eating quality. The Irish Grey variety (fig. 3) is grown to some extent in Georgia

and other southeastern sections and sometimes brings a little higher price on certain markets than the Tom Watson. Thurmond Grey is similar in type and color to Irish Grey. It has deep-red flesh and a thin rind, but owing to the firmness of the flesh it stands shipping remarkably well. In California the varieties known as Excel, White-Seeded Angelino, Black-Seeded Angelino, Florida

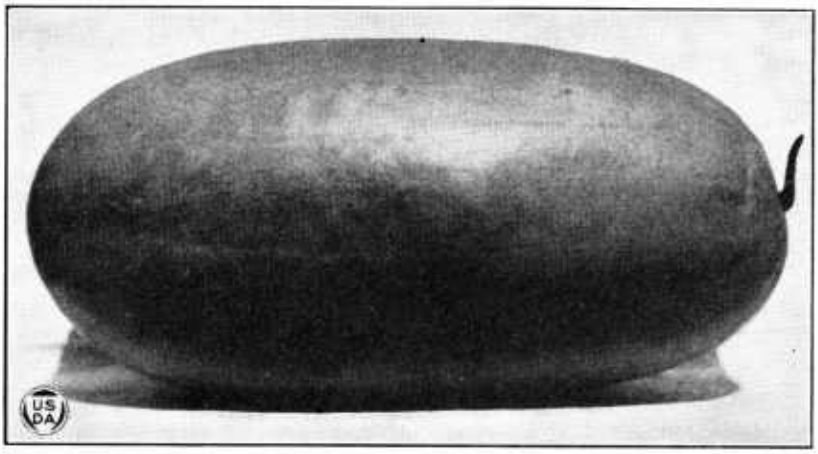

FIGURE 3.—A watermelon of the variety known as Irish Grey.

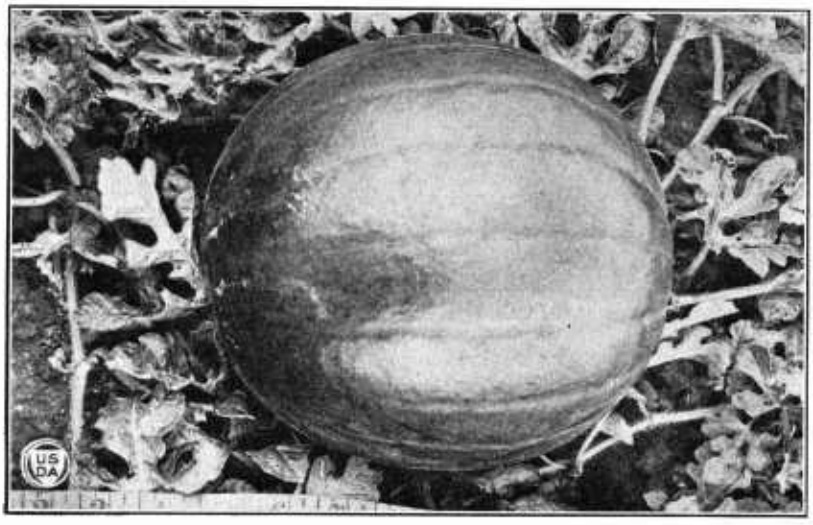

FIGURE 4.—Type of round watermelon known as Winter Queen, Winter King, Alaska, or Klondike.

Favorite, and Klondike are most important. Stone Mountain or Dixie Belle is very popular in the South and is the leading market watermelon of the round type. It is very sweet and has a tender, melting flesh when well grown. For home use and local marketing Tom Watson, Kleckley Sweet, Dixie Belle, Florida Favorite, Excel, and Irish Grey are extensively planted. There are also a number of

local varieties having special merit under the conditions under which they are grown and used.

Cuban Queen is a medium-sized, round melon which is frequently grown for nearby marketing. It has a light green, mottled rind and its flesh is a rather deep red, quite sweet when well grown, but occasionally a little coarse-grained. It also has a tendency to develop cracks and cavities in the flesh if allowed to become slightly overmature.

Recently there has appeared upon the markets late in the season after the regular crops of watermelons are practically gone, a small round melon grown in Colorado and California and sold under the names Winter Queen, Winter King, Alaska, Klondike, etc. Varieties of this type were introduced from the Volga River section of Russia probably by Russians who settled in the Rocky Ford district of Colorado. These melons are also grown by the Japanese in California. They are round or slightly oblong, of the type shown in figure 4, and about 8 or 10 inches in diameter, having a thin rind but standing shipment fairly well when packed four to six to a crate. The quality is only medium, but the melon is an excellent keeper and on that account a decided addition to the list of varieties grown for market.

GOOD SEED, ITS IMPORTANCE AND HOW OBTAINED

A pound of good watermelon seed is sufficient for planting an acre, with a small amount left over for replanting. Poor seed has been responsible for many of the failures and low yields of watermelons. There is little excuse for this, as it is a comparatively easy matter to produce high-grade watermelon seed. Unfortunately, the methods followed in the production of commercial watermelon seed have in the past often been such as to make it difficult to secure a good grade of planting seed on the open market. A few seed growers and dealers, however, are offering watermelon seed of high quality at fair prices, and growers are advised under all circumstances to secure their seed supply from a dependable source.

Any watermelon grower can grow his own seed with very little trouble, as a small number of choice melons will furnish enough seed for planting his crop; in fact, 4 or 5 average melons of the Tom Watson variety will yield a pound of seed. The proper method of selecting the seed melons is to go through the field prior to the first picking and mark a number of melons having the desired type, color, and general characteristics. In making the selection, vigor and freedom from disease of the vine should be taken into consideration. The individual melons selected for seed saving should be free from anthracnose markings and decay. One of the best methods of marking them is to tie pieces of white cloth to the stems of the melons. The marked melons should be allowed to remain on the vines until fully ripe, then carried to a safe place, and after 2 or 3 days of additional ripening should be opened and the seed separated from the pulp. An acre of watermelons grown exclusively for seed purposes will yield on the average about 200 to 250 pounds of seed.

The usual method of saving seed is to split the melons lengthwise, scrape out the seed-bearing pulp, as shown in figure 5, and allow

it to ferment in wooden tubs or barrels for 24 to 36 hours, or until the pulp begins to sour and float to the top, the seed settling to the bottom. Water is then added, the pulp poured off, as shown in figure 6, and the seeds washed through several changes of clean, cold

FIGURE 5.—Removing seeds and pulp from halves of watermelons.

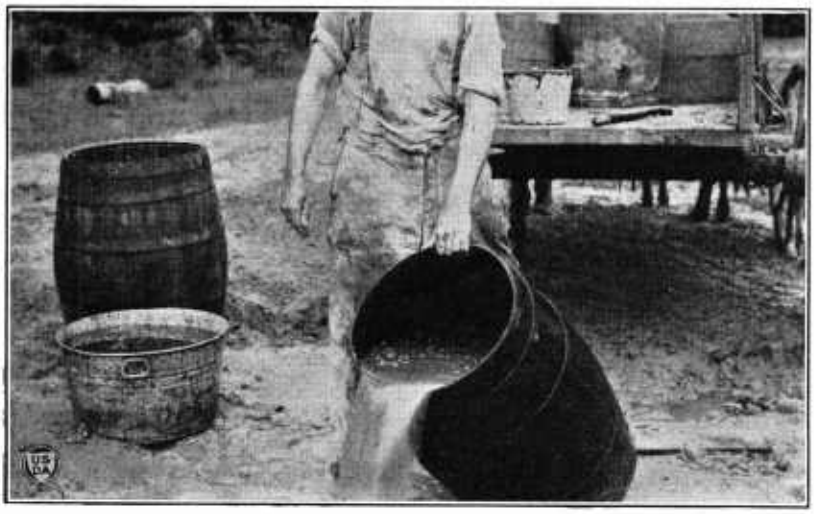

FIGURE 6.—Washing fermented pulp off watermelon seeds that have settled to the bottom of a barrel.

water. The seeds should then be spread thinly on cotton sheets and dried, being stirred occasionally during the drying process.

Where any considerable quantity is handled, trays or frames of laths about 3 by 6 feet in size, covered with thin burlap or cheesecloth, are desirable for drying the seed. After the seeds are thor-

oughly dried on the sheets or trays they should be stored in rather small quantities in thin cotton or burlap bags and kept where they will be safe from mice in a cool, dry, well-ventilated place. Some seed growers maintain that it is best to cut off the ends of the melons, saving the seed from the center portion only. There is nothing to indicate that this has any particular advantage, however, the essentials being that the seeds are fully ripe and that they are given the proper care after their removal from the melons.

Where a grower has an especially fine lot of melons that are uniform and true to variety for which there is no market, it will often pay him to secure some barrels and other equipment and save the seed, as described above. Seed saved in this manner may be sold to the melon growers in the immediate neighborhood the following season, thus turning what might have been a complete loss into a reasonable profit. A great deal can be done through cooperation among growers in the matter of developing local supplies of high-grade watermelon seed.

PLANTING DATES AND METHODS OF PLANTING

Planting dates vary with the locality. In southern Florida planting begins early in February, in southern Georgia during early April, and in the northern commercial watermelon-producing sections from May 10 to 20. Because the young plants are easily injured by frost the seed should not be planted until the soil is warm and danger of frost is past. To avoid the possibility of loss from frost, growers frequently follow the practice of putting in an additional planting of seed 3 or 4 inches in one general direction from where the original planting was made, this being done from 3 to 5 days after the first planting. In case of actual injury a third seeding is sometimes made to insure a stand of plants. The thinning of the plants should begin as soon as they are up, leaving first about 3 plants in a hill and later reducing the number to 2 or in most cases 1. Where a second or a third seeding is made and the first comes through in good condition, those of the first seeding should be left, provided they are in good healthy condition.

Planting distances vary to some extent but not greatly in the different commercial watermelon-producing localities. A few of the southeastern growers plant as closely as 8 by 10 feet and others 10 by 12 feet, but 10 by 10 feet is perhaps the more popular planting distance. By having the rows 12 feet apart, cultivation can be continued longer in one direction, while spraying with power sprayers is made easier. The hills should always be checked in both directions in order that the crop may be cultivated both ways during the early part of the season. Texas growers, who secure the greatest return per acre, plant at distances averaging 12 by 12 feet. Many of them give the hills practically the same space by planting 10 by 14 feet. This arrangement gives approximately 300 hills per acre. Where melons are planted in continuous rows in one direction only, the rows are spaced 14 to 20 feet apart and the plants thinned to a single plant every 6 or 8 feet. When planted in hills, the plants are thinned to 1 or at most 2 plants in a hill. The best yields of high-grade melons are procured where the hills are spaced at least 10 by 12 feet and the melons thinned to one plant in a hill. This

distance gives about 360 hills to the acre, and with 2 melons to the hill the yield should be around 700 melons to the acre, or 450 to 500 marketable melons.

The methods of planting watermelons are similar in all localities, the custom being to harrow the ground and then mark off in both directions. Where manure is worked into the hills the seeds are usually scattered slightly and pushed into the soil with the finger one-half to 1 inch deep. Where no manure is used the seed is often planted directly in the cross marks and covered by hand or with a hoe. Three seeds are sufficient, but six or seven are usually planted in each hill, to insure a good stand. Where the melons are planted in a continuous row or drill the seed is often put in by means of either a hand drill or a one-horse drill. A seed drill, however, usually involves the use of larger quantities of seed than are required for hand planting.

CULTIVATION

The cultivation of watermelons should begin within a few days after the plants come through the ground. Where the hills are carefully checked in both directions the land can be worked for some time with a harrow or weeder with a little hand work directly around the hills. Some growers follow the practice of running along the rows with a one-horse cultivator or a two-horse riding cultivator and then working out the middle with a harrow. As a rule, about three or four general cultivations will be sufficient, but frequent cultivations early in the season not only keep the ground in good condition but prevent the growth of weeds. Later, when the vines begin to spread, it may not be possible to cultivate both ways but in one direction only. By training the vines more or less in a well-defined row cultivation can be continued in one direction until the melons are two-thirds grown. It should be borne in mind that the watermelon is a comparatively shallow-rooted plant and that the roots often extend farther than the vines. Therefore, it is essential that the land be worked shallow, especially near the hills and after the vines begin to run freely.

"PRUNING"

Growers of high-grade watermelons have found it desirable to thin or "prune" the melons in order to get a melon of shipping size. This does not mean pruning the vines themselves, but reducing the number of melons on each vine. It has been found that any cutting back or disturbance of the vine injures the development of the melons. The usual custom among growers is to wait until there is a good set of melons on the vines, the largest being about 4 inches in length, and then to remove all but two of the best melons from each hill or vine. Sometimes as many as three or four melons are left at first, the two best ones remaining after a second pruning, which occurs about a week after the first. It is doubtful, however, whether two prunings pay, for as a rule the work can all be done at one time. Pruning should be done only when the vines are dry, so as to avoid the spread of anthracnose.

In order to avoid stooping to cut off the undesirable melons, some growers use a long-handled knife or cutter with which the melons

can be snipped off. Others use an ordinary penknife, as they consider it necessary for the person doing the pruning to examine the melons more carefully than can be done without stooping over. A cutter can easily be made by sawing a slit in one end of a broomstick, inserting a thin piece of steel, and fastening it with rivets or screws. The outer edge of the steel blade is kept sharpened. In using the cutter the blade is simply placed upon the stem that attaches the melon to the vine, and with a slight downward thrust the stem is severed close to the melon, care being taken that the vine is not cut or injured.

Pruning causes the entire vigor of the vine to go to the development of the melons that are left and usually results in the production of a high percentage of marketable melons. Later in the season after the marketable melons are practically mature, the vines often put on a second crop, which is either sold locally or used for hog feed. Some of the smaller varieties are not pruned so closely, four to six melons being left on the vine. Melons grown for home use are seldom pruned, as the question of size is not so important.

INSECT ENEMIES OF THE WATERMELON

The watermelon plant is subject to attack by numerous insects. Of these, the melon aphid (*Aphis gossypii* Glov.), the striped cucumber beetle (*Diabrotica vittata* Fab.), and cutworms are considered enemies of primary importance.

MELON APHID

The melon aphid,[3] or melon louse, does much harm to the growing plant in reducing its vitality and deforming the leaves. Its presence is first manifested by a slight curling of the leaves, and later by an excretion of the insect known as "honeydew" and also by the appearance of large numbers of ants or lady beetles. When the melon aphid becomes very abundant, the leaves curl up and the growth of the plant is greatly retarded, and oftentimes the plant dies. Since leaf curling is also a symptom of certain diseases, the undersides of the leaves of the affected plants should be examined for aphids.

For the control of the melon aphid, nicotine, applied in the form of a dust or in a spray solution with soap, has given successful results. Nicotine dust consists of a mixture of nicotine sulphate (40 percent nicotine) or nicotine solution with hydrated lime or a similar carrier. The mixtures should be prepared in such a manner as to contain 2 percent of nicotine. The underside of the leaves where the insects feed can be more readily reached with a dust than with a spray. The fine particles of dust carrying the killing agent, nicotine, drift through and around the plant foliage and lodge on the underside of the leaves. Also, if the dust is applied carefully to the leaves of the terminal shoots which have begun to curl, sufficient quantities to kill many of the lice will enter the curled leaves.

The dust is best applied when the temperature is high, 70° F. or higher, and the air is relatively quiet. In general, these conditions

[3] For detailed information concerning the melon aphid and its control, including the preparation of nicotine dust, consult Farmers' Bulletin 1499, The Melon Aphid and Its Control.

prevail in the morning after the dew has left the plants. Nicotine dust should not be applied to wet foliage. For plants that have reached the fruit setting stage this dust mixture should be applied at the rate of 30 to 45 pounds to the acre.

The spray recommended for control of the melon aphid consists of a soap solution of commercial nicotine sulphate, 1 part to 1,000 parts of water, prepared according to the following formula:

For large quantities:		
Nicotine sulphate solution (40 percent nicotine) (6 fluid ounces)	pint	⅜
Soap	pounds	4
Water	gallons	50
For small quantities:		
Nicotine sulphate solution (40 percent nicotine)	teaspoonful	1
Soap	inch cube	1
Water	gallon	1

The quantity of soap required to give proper spreading of the spray mixture varies with the hardness of the water, more soap being needed with hard water. When the spray draws up in drops and runs from the leaves, more soap should be added.

The value of the spraying depends upon the thoroughness of the application. As in the dusting operation, it is important that the underside of the leaves be coated thoroughly with the spray material, and this is best accomplished by the use of an angle nozzle.

STRIPED CUCUMBER BEETLE

The striped cucumber beetle is especially injurious to young plants just after they come through the ground. A dust containing 2 percent of nicotine, prepared as for use against the melon aphid and applied at the rate of 15 to 25 pounds per acre, has proved effective in controlling this pest under some conditions. A mixture of 1 pound of calcium arsenate with 15 pounds of gypsum (land plaster) is also useful. The melon fields should be watched closely and one of these insecticides applied as soon as the beetles appear. The dust should be applied directly to the hill by means of a duster that blows the dust with considerable force. Under ordinary conditions two or three applications of dust will keep the seedling melons free from injury. Spraying the small plants with a bordeaux mixture consisting of 3 pounds of copper sulphate, 3 pounds of lime, and 50 gallons of water, to which is added 1½ pounds of calcium arsenate, is a fairly promising method of controlling this insect. Recent experiments have indicated that a mixture of derris dust containing 0.5 percent of rotenone, and gypsum or talc as a diluent, is effective when applied directly to the beetles.

Caution.—Sprays or dusts containing arsenicals or other poisonous materials of a stable nature should not be applied to the melons unless the residue can be removed by washing.

CUTWORMS

Cutworms sometimes cut off the stems of young watermelon plants at the surface of the ground. Poisoned bait is the best remedy for these pests.[4] This bait can be made by mixing thoroughly 1 pound

[4] For detailed information concerning the preparation of this bait, see U. S. Department of Agriculture Leaflet No. 2, Cutworms in the Garden.

of paris green or white arsenic with 25 pounds of dry bran, and then adding from 15 to 20 quarts of water in which 2 quarts of sorgo sirup or cheap molasses has been mixed. Only enough liquid to make a crumbly mass should be added. For small quantities of the bait the proportions are one-fourth of a pound of the paris green or white arsenic, 5 pounds (1 peck) of the dry bran, and from 3 to 4 quarts of water in which a pint of the sorgo sirup or molasses has been mixed. The poison should be mixed in the morning and applied late in the evening, so that it will be moist and attractive to the cutworms when they begin to feed. If the presence of cutworms is suspected, the bait should be broadcast thinly over the entire field before the plants are up. After the plants are above ground, the bait should be scattered thinly on the ground around the hills. From 10 to 15 pounds of the wet bait per acre is enough for 1 application, but 2 or 3 applications at 2-day intervals may be required to control the cutworms.

Caution.—Keep the poison and the poisoned bait away from farm animals, poultry, and irresponsible persons.

For additional information regarding the insects mentioned in this bulletin and other insects attacking melons and related plants, the grower is advised to communicate directly with the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D. C. If the insects causing injury are not recognized by the grower, specimens should be sent for identification, together with an explanatory letter, to the State agricultural experiment station, or to the Bureau of Entomology and Plant Quarantine. Specimens so forwarded should be placed in a vial of some such preservative as formalin and wrapped carefully to avoid breakage or loss in transit.

DISEASES OF THE WATERMELON

Watermelons are subject to several very destructive diseases, the most important of which are wilt, root knot, anthracnose, and stem-end rot.

WILT

Fusarium wilt is in some sections one of the most destructive of the field diseases. The experience of many years has established the fact that two successive crops of watermelons cannot be grown on the same land without risk of failure and that 10 or more years must elapse before old melon fields may be replanted with reasonable safety. The control of this disease lies in planting on new ground or in a rotation of sufficient length to safeguard against loss. In laying out rotations, care should be taken to locate melons so that the field will not be washed by drainage water from higher land that was planted to melons the previous year. As the causal organism may live over in manure, it is important to avoid the use of manure from barnyards where stock has fed on refuse from melon fields.

Several years ago the United States Department of Agriculture developed an oval, wilt-resistant watermelon named the "Conqueror." However, it was never widely used because of a changed market which called for a long melon of the Tom Watson type.

The workers of the Iowa Agricultural Experiment Station have recently introduced three new varieties of watermelons which are resistant to the wilt disease. Investigations now being carried on in Florida, Illinois, and California give promise of other wilt-resisting types.

ROOT KNOT[5]

In certain sections of the melon territory, particularly where the land has been under cultivation for a number of years, the control of root knot is a serious problem. Planting on new land or long-time rotations with immune crops are the surest safeguards against root knot (fig. 7).

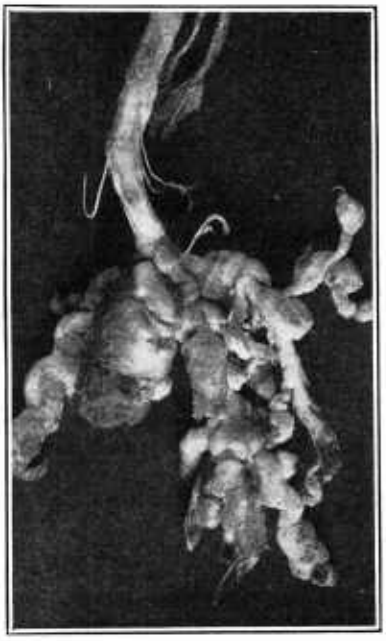

FIGURE 7.—Root knot. Melon root, showing galls caused by nematodes.

ANTHRACNOSE

Anthracnose affects both leaves and fruit and is probably the most important of the watermelon troubles. The causal organism has been so widely distributed on the various vine crops that the disease is almost certain to occur in any growing section if there is prolonged rainfall. Its presence is first made known in the field by the characteristic irregular, dark, dead spots which appear on the leaves, eventually causing them to curl up and die. From the foliage and stems the disease spreads to the fruit, where it causes water-soaked spots or pimplelike lesions, which under moist conditions becomes sunken and covered with a pink layer of spores.

If the trouble becomes general in a field before the melons have ripened, the crop is usually a complete failure. It often happens, however, that the disease appears as the melons are approaching maturity. Under these circumstances, although the pockmarked fruit may be harvested and shipped, it often rots in transit and at best brings but a poor price at the market.

Injury due to anthracnose can be greatly reduced by seed treatment, followed during the growing season by thorough spraying of the vines with bordeaux mixture (3–6–50), or dusting with 20–80 copper-lime dust when the vines are fairly dry. Progressive growers have come to regard spraying as good insurance against loss from anthracnose. The success of this measure depends largely on the extent to which the healthy foliage can be kept completely covered, both the upper and lower surface of the leaves, with a thin protective coating of properly prepared bordeaux mixture. In order to

[5] For detailed information concerning root knot, see Farmers' Bulletin 1345, Root Knot: Its Cause and Control.

accomplish this, it has been found best to avoid the application with "set" spray booms and use the "trailer" method of application, a man directing the discharge from an extension rod which is attached

FIGURE 8.—Power sprayer fitted with four lines of hose for spraying melons.

to the machine by a hose, as shown in figure 8. In order to avoid vine injury caused by pulling the hose about, small boys may be employed to carry the hose above the ground, or homemade booms

FIGURE 9.—Platform and equipment for mixing and loading spray materials.

may be arranged to bring it out over the vines on either side of the spray pump. In case this latter method is used, it is a good plan to construct these booms so that they may be folded in order that the machine may be housed.

The preparation of spray materials will be greatly facilitated if a raised platform is provided from which the materials can be drawn by gravity into the spray pump for mixing (fig. 9).

First applications of dust or spray should be made when the plants are beginning to run, and an additional application should be given 7 to 10 days later. Spraying or dusting should be continued at intervals of 10 days to 2 weeks, provided the weather favors the spread of the disease and the market prospects are such as to warrant the expense.

STEM-END ROT

Stem-end rot is caused by a fungus closely related to or identical with the organism which causes Java black rot of sweetpotatoes, one of the stem-end rots of citrus fruits, a cotton-boll rot, and diseases of some other plants commonly grown in warm climates. It is particularly destructive in the case of melons shipped from the Southeastern States. In the spring this fungus is found in and around melon fields fruiting on dead stalks of coffee weed, corn, cotton, and other plants. Spores or fungous seed bodies are washed into the soil or carried about the fields on implements or by the wind. Provided these find lodgment in a wound or on the cut stem of a watermelon, decay soon results. As the season develops, melons may be found rotting in the field as a result of infection at imperfect blossom ends or at cuts or anthracnose pockmarks. These rotting melons are the chief source of infectious material which serves to bring about stem-end rot in transit.

As has been stated, infection and subsequent decay occur when these spores get into wounds affecting the stem or rind of a melon. Bruises and cuts of the rind can be prevented by careful handling, and this is most important. A cut stem, however, is a wound that is present on all melons, and it is to prevent infection at this point that the practice known as stem treatment has been recommended.

In the past the presence of stem-end rot has frequently been attributed to the use of large quantities of fertilizers or to the use of nitrate of soda as a side dressing. This is not the case, and growers may safely continue to fertilize their melon fields in the manner that experience has shown to produce the earliest and best crops. All varieties of watermelons now grown commercially have proved when tested to be subject to stem-end rot.

The control of the stem-end rot in transit involves field sanitation supplemented by reclipping and treating the stems of the melons with a disinfectant paste when packing the car, or when loading them on trucks or wagons to be hauled to nearby markets. As a first precaution, in order to avoid contamination with hands and implements, the men who are cutting the melons in the field should never touch or cut into a decayed melon. The fruit should be clipped with the longest possible stems and hauled to the car without delay, as the harvested melons left in the field or on wagons from one day to another may become infected and rot in spite of a late treatment. Handle carefully to avoid injury to the rind, and load only sound melons with fresh green stems. As each tier of melons is placed in a car, cut a short piece from the stem by means of a sharp knife and immediately treat the freshly cut surface with the disinfectant paste.

The method of cutting and treating the stem is shown in figure 10. In cutting the stems at the car it is desirable that the remaining stem be left as long as possible, as most dealers like to make a fresh cut when the melons are placed on the market, thus giving them a fresher appearance.

The paste used for treating the melons to prevent stem-end rot in transit may be prepared in 1-gallon lots as follows: Use an enamelware kettle of sufficient size. Place 3½ quarts of water and 8 ounces of bluestone in the kettle and bring the mixture to a boil over a good fire. While the water is heating mix 8 ounces of starch with 1 pint of cold water, stirring until a milky solution free from lumps is obtained. As soon as the bluestone is entirely dissolved and the solution in the kettle is boiling, add the starch mixture, pouring it

FIGURE 10.—Cutting and treating the stems of watermelons to prevent stem-end rot in transit. Usually, the boy clips the stems as well as pastes them, so that the operation does not cause the packer to lose time.

in a slow stream and stirring the hot solution vigorously, to prevent the formation of lumps. Stir the boiling mixture until the starch thickens evenly, which should not require more than 1 or 2 minutes boiling after the addition of the starch. One-quart glass fruit jars with porcelain-lined tops or glass tops make convenient containers for the paste. This preparation is most satisfactory when used fresh. Commercial paste for treating watermelons to prevent stem-end rot can now be purchased in practically all sections where this treatment is necessary.

Cars that have contained melons affected with stem-end rot should be thoroughly cleaned and, if possible, disinfected by spraying with a 2-percent bluestone solution before they are lined with paper, as the paper alone will not prevent the infection of the fresh shipment of melons. Five gallons of the 2-percent bluestone solution and 20 minutes' time of two men with a hand sprayer will be sufficient for treating a car.

GATHERING AND LOADING WATERMELONS

Considerable complaint has arisen in the past on account of the shipment of green melons to the market, and it is highly important that southern growers of early melons give more attention to the proper maturity of the melons grown for the northern markets. There are several well-known tests for the maturity of watermelons, but the most practical one in use is that of the change in color, especially that of the lower part of the melon where it rests upon the ground. This consists of a slight yellowing of the white background color, which previous to maturity is a pale white. In the final analysis the sugar content of the flesh and the ripeness of the seeds is the real test, but this cannot be applied in a practical way; therefore exterior indications are the only ones by which to judge the maturity of the individual melons.

Melons should be cut from the vine rather than pulled or broken off. Ordinary penknives with rather slender blades about 2¼ inches in length, or stiff-backed knives, such as are employed for peeling fruit, are adapted for cutting melons from the vines. Care should be taken to leave the stems as long as possible. As the melons are cut from the vines they are either carried direct to the roadways or are turned over so that the "tote boys" following the cutters can readily see them and carry them to the roadways. Melons should not be stood on end either in the field or on the wagons.

Before the harvesting of the melons is begun, the field is divided into sections of about 8 to 10 rows each, and the vines of every eighth or tenth row are laid together so as to form a roadway wide enough for wagons or trucks to pass through. If the vines are sprayed, it is customary to keep a roadway open every sixth row for the passage of the machine. These roadways are then used for wagons at harvest time. As the melons are carried to these roadways they are placed in small piles, as shown in figure 11. Care must be taken in laying the melons down (1) to avoid injury to the skin from the numerous small sticks that are so prevalent in new ground and (2) to pile the melons one upon another carefully, to prevent bruising. The melons should not be piled more than three high along the driveways and in no case should they be stood on either end.

All types of wagons are employed for hauling melons from the field to the car or loading station. In fruit-growing sections where the flat-top orchard wagon is in use, these wagons are found desirable for hauling melons, but in most sections they are hauled in ordinary farm wagons. It is desirable, however, in all cases that a bed of about 5 inches of straw or soft pine needles be placed in the bottom of the wagon and that the sides and edges of the wagon bed be padded with burlap or canvas. Before the movement of the melon crop begins the wagon bed should be inspected carefully to see that no nails or cleats with sharp corners are left to injure the melons. Where ordinary farm wagons are employed it is very desirable that they be provided with an extra thick bed of straw and bolster springs, to lessen the jolting of the melons.

Motor trucks of 1 to 2 tons capacity are frequently used for hauling the melons direct from the field to the loading point. In cases where the fields are so soft that the motor trucks cannot safely be driven directly into them, the melons are hauled to the roadway

with teams and there reloaded upon the trucks. This reloading is undesirable and will not pay where the total haul does not exceed 2 or 3 miles, but where the haul is 4 to 6 miles the work can be done more rapidly, and often cheaper, with the trucks. With a little care the motor trucks can usually be driven through the fields and the extra handling of the melons avoided. In some cases melons are hauled by team and unloaded in long, flat piles under the shade of trees, and then reloaded on motor trucks. A motor truck with well-balanced springs, especially those with pneumatic tires, will handle the melons fully as easily and with fewer injuries than farm wagons, even though equipped with bolster springs. At one shipping point in Florida the cost of hauling melons with a small motor truck from the entrance of the field to the car, a distance of 5 miles, was $15 a car, the work of handling a carload being done in 1 day.

FIGURE 11.—Watermelons piled at a roadway ready for loading on wagons. Melons should never be stood on end, as shown in this illustration.

The usual method of loading the melons from small piles to the wagon or truck is to have two men on the ground and two on the wagon or truck and simply pass the melons, one at a time, from the ground to the wagon or truck. In no case should the melons be loaded more than five deep, nor should the laborers be allowed to either walk or ride upon the load. The most careful growers cover the load of melons with a piece of canvas to protect them from the hot sun on the way to the cars. All melons cut from the vines during the day should be placed in the car, and not allowed to remain in the field, on the wagon, or piled in the center of the car overnight. Plans should be so made that the car can be loaded, closed, and billed out the same day that the melons are cut from the vines. It is of course desirable that the car start movement the same evening.

The work of handling the watermelons from a wagon or truck into the car is usually done by three men, one on the wagon or truck as shown in figure 12, one just inside the car door, and one in the

rear of the car, who places the melons in position. Before a car is loaded, a bed of straw or pine needles about 3 inches in depth is spread upon the floor. Losses in transit frequently occur as a result of using wet hay, straw, or pine-straw bedding, especially in closed cars, where the moisture given off from the bedding causes a high humidity favorable to the development of decay organisms. A supply of thoroughly dry bedding material should be provided, stored in a shed or barn before the opening of the watermelon-shipping season, and hauled to the cars as needed. Where wet bedding is used the melons in the lower tier are almost certain to decay on the side which rests on the bedding. Before watermelons are loaded into box cars and ventilator cars a strip of building paper 3 feet in width is stretched around the inside of the car and held in place with tacks, to protect the melons from injury and chafing against the sides of the car, and possible contact with chemicals

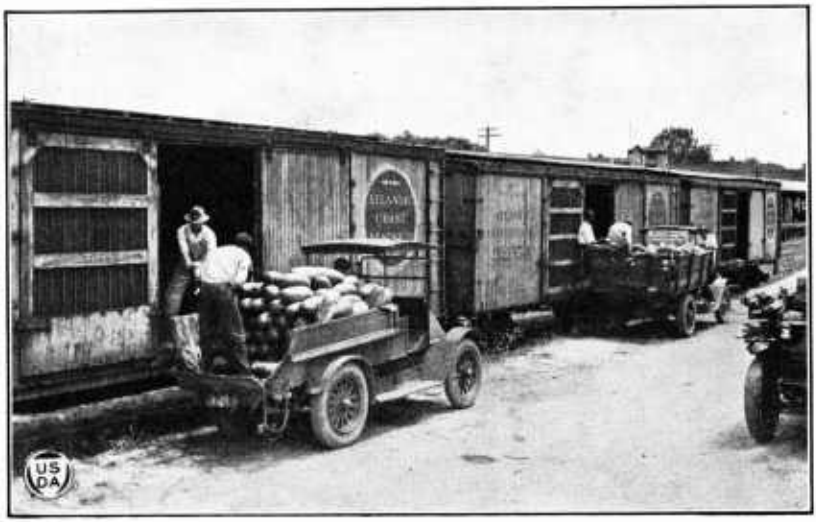

FIGURE 12.—Handing watermelons from trucks to cars at the loading station.

left on the car walls from some earlier shipment of fertilizers or other injurious chemical salts.[6]

The cost of the materials, including the straw, paper, disinfectant paste for the stem-end treatment, and boards to place across the doorways, is usually about $6; and the entire cost of loading a car, including hauling the melons from the field, placing them in the car, the materials for preparing the car, and the stem-end treatment, ranges between $20 and $35.

The arrangement of the melons in the car depends upon their size. Melons weighing 22 to 36 pounds or over are usually loaded in 4 tiers and those weighing 18 to 20 pounds in 5 tiers, with 14 melons across the car in the bottom layer, 13 in the second, 14 in the third, 13 in the fourth, and 14 in the fifth layer, as shown in figure 10. The stems are always placed toward the doorway. As there is consider-

[6] For further information on chemical injury to watermelons in transit, see U. S. Department of Agriculture Circular 74, Chemical Injury to Watermelons in Transit.

able difference in the width of cars, the arrangement of the melons will depend not only upon their size but upon the type of car being loaded.

Where help is scarce, the melons are often piled in the doorway of the car as they come from the wagons and are then placed in their proper position between the arrival of the loads. This practice is objectionable, in that it tends to bruise the melons and increase the liability to losses during transit. As each tier of melons is placed in position in the car the stems are clipped and the stem-end rot treatment applied.

In clipping the stems for stem-end treatment a sharp knife should be used and a clean smooth cut made. Shears or clippers are not adapted for this work as they have a tendency to bruise or crush the stems. The disinfectant paste should be applied by means of a small brush immediately after the stem is cut. Melons that are brought to the car late in the evening should not be allowed to remain overnight without stem-end treatment, as the spores of the disease may develop during the night to such an extent as to infect the melons and cause rot, even though the treatment is applied the following morning.

Watermelons are shipped in stock cars, ordinary box cars, ventilated fruit cars, and in special cases of long haul, such as when Russian melons are shipped from California to eastern markets, refrigerator cars are employed. The type of equipment varies considerably with the locality. Watermelons grown in Florida and the South Atlantic States are shipped largely in box cars and ventilated cars; those grown in Texas and southeast Missouri are largely shipped in stock cars. Ventilated cars, such as are employed by the railways of the South Atlantic coast territory for the handling of potatoes, cabbage, beans, and cucumbers, are especially adapted for watermelons. Box cars, unless provided with screen doors, become too hot during transit. They are always objectionable when not equipped with end ventilators. Stock cars provide an excess of ventilation, but require that the lower cracks be stripped to prevent melons being plugged or gouged in transit. Stock cars must be thoroughly cleaned and disinfected before being loaded.

FACTORS GOVERNING THE COST OF GROWING WATERMELONS

Production costs vary considerably one year as compared with another and in different localities but will range between $27.50 and $42 per acre. Watermelons are what might be termed a cheap crop to produce, but, on the other hand, the returns are often so small as to render reasonable profits very uncertain. If it were not for the fact that watermelons often serve as a catch or clean-up crop it is doubtful whether they would be grown to such an extent as at present.

The factors that should be taken into consideration in determining the cost of producing a crop of watermelons are as follows: Interest on value of land or reasonable rental of land, cleaning and plowing land, fertilizers, seed, fitting land and planting, cultivation, spraying, thinning the melons on the vines, gathering, hauling, and loading into cars and stem-end treatment where necessary. To the above should be added a reasonable allowance for supervision, wear on

tools and equipment, and interest on borrowed capital. Credit should be given the watermelon crop for any improved condition of the land that results from its cultivation. This would apply mainly to newly cleared land on which watermelons are the initial crop.

YIELDS PER ACRE AND RETURNS

The average yield of marketable watermelons, is, as a rule, about one carload to every 2½ acres. In many cases, owing to adverse weather conditions and other causes, the yield is as low as 1 car to 5 acres. The best growers, however, harvest a carload from 2 acres. In California the yield is calculated in tons, 7½ to 8 tons an acre being considered a good yield.

Occasionally the first cars of early watermelons bring as much as $700 to $800 each at the loading point, but $300 to $350 a car is considered a good price. More often watermelons sell for about $150 a car at the loading point, and occasionally for as little as $75. When the price drops below $75, shipments lag or stop altogether. Recently the transportation companies have required the prepayment of freight on watermelons, and at a price as low as $75 a car and the freight $150 to $200 a car the risk is too great. All things considered, a price of $150 a car at the loading point is considered the minimum for safety and a reasonable margin. Under present conditions a car of watermelons ready to harvest will cost the grower not less than $55, or more often $80. Add to this $35 to cover the cost of loading, and the total cost on board the car will be from $90 to $115. On this basis when prices are low it is a question whether melons shall remain in the field and become a total loss or be loaded with the chance of recovering part of the cost of production. Local marketing in small lots will sometimes yield reasonable returns.

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